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eCardiac

Project: Personal ECG (Electrocardiogram) Monitor

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Document Revision History

Revision Number	Revision Date	Description	Rationale
0.1	7/16/2012	Rough Draft	Compile all subsections
0.2.1	7/17/2012	Rough Draft Update	Internal Review
0.2.2	7/17/2012	Rough Draft Update	Requirement Scrubbing
0.2.3	7/25/2012	Rough Draft Update	Requirements Adjustments
.3	7/30/2012	Gate Review	Final revision before gate review. Includes adjustments from feedback.
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1. Product Concept

This section describes the overall concept of the Personal ECG Monitor by giving a brief and concise description of the purpose, audience, and proper use.

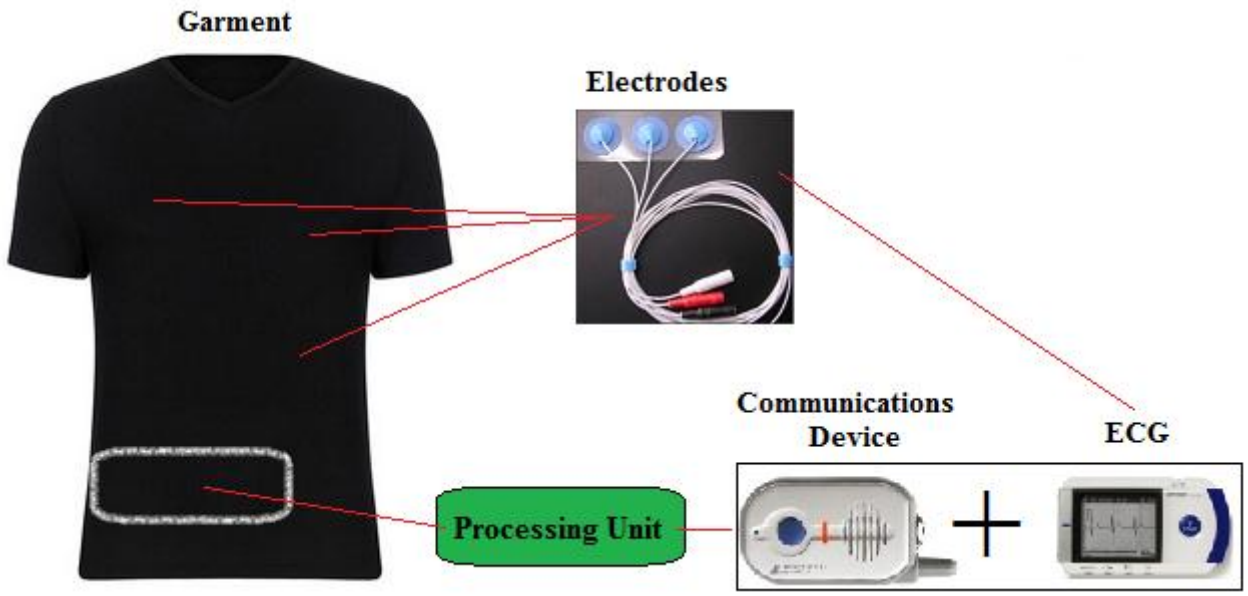
1.1 Purpose and Use

The Personal ECG Monitor is to be worn by a client and will regularly take ECG readings. The product will monitor readings and make note of noticeable changes. If these changes indicate that the patient is experiencing heart attack like symptoms it will contact emergency personnel.

The product should be worn daily. The product should be used in a controlled environment where activity is regular and stable. The product should not be used while participating in strenuous activities.

1.2 Intended Audience

Our product is intended to offer effective constant monitoring for high risk heart attack patients. The product is intended to replace or alleviate the need for on premises personnel. This product is ideal for stay at home or assisted living patients. The ideal patient is in need of constant monitoring and has limited mobility.



Product Concept: Figure 1-1

2. Product Description and Functional Overview

Herein is provided a general description of the eCardiac system. The description is composed of its primary function, key inputs/outputs, and intended use.

2.1 Features and Functions

The eCardiac's central purpose is to give high risk heart attack patients added mobility and peace of mind by accurately monitoring the heart in an unobtrusive manner while outside the hospital environment. When observed heart activity is symptomatic of a heart attack, the eCardiac's critical function turns to contacting emergency operators in order to allow them the ability to probe the user for more information needed in deciding when critical care is necessary. Key limitations of the device include participating in moderate to extreme activities such as sports or light jogging. Leaving their designated home environment also limits the device's ability to ensure communication with emergency care when needed.

The whole of the device consists of a form fitting shirt with slots for each electrode and a holster for the container that holds the eCardiac processing unit and notification device. The electrode wires that connect the electrodes to the processing unit are concealed by the shirt. The processing unit then communicates wirelessly the status of the patient as perceived by eCardiac.

2.2 External Inputs and Outputs

The initial step in heart monitoring is data acquisition from the user. Accurate data requires that the user be constantly connected with up to ten electrodes. Each electrode's specific placement ensures an accurate picture of internal cardiac activity. Specific placement of each electrode is established by a garment worn under the patient's normal clothing. Placed properly, these electrodes are able to gather information necessary for signal interpretation.

The next step in heart monitoring is handed to the central controlling device where data interpretation occurs. After receiving input from the electrodes the data is run through filters that will transform what could be viewed as noise into a waveform signal that represents the familiar heart beat many are familiar with viewing in hospital rooms worldwide. This filtered signal is then monitored for specific patterns that are indicative of heart attacks symptoms.

In the last step, a heart attack or symptoms that would indicate its onset are sensed and the controller sends as output the necessary information to eCardiac's notification component. The notification component has been preprogrammed with emergency response procedures to use when notification is necessary. Response procedures include contacting a remote response emergency center and storing relevant data such as heart rhythms on the device for later retrieval by qualified personnel.

Source	Input	Output	Destination
Body	None	Voltage at particular measuring point	Placed Electrode
Electrodes	Raw voltage difference readings from the host body	Analog unfiltered transmission of readings	Controller
Controller	Analog unfiltered transmission	Filtered digital waveform	Controller
Controller	Filtered Digital waveform	Probability measurement of possible heart attack symptoms sensed and input is stored locally	Controller
Controller	Probability measurement of possible heart attack	alert and relevant information	Notification Device
Notification Device	alert and relevant information	contact emergency response with data	Emergency Response Center
Emergency Response Center	contact emergency response data	decision for critical care	User/Local emergency authorities

Table 2-1: External Inputs and Outputs

2.3 Product Interfaces

Below are included sample mockups of what operational interfaces will be available to the end-user and administrators.

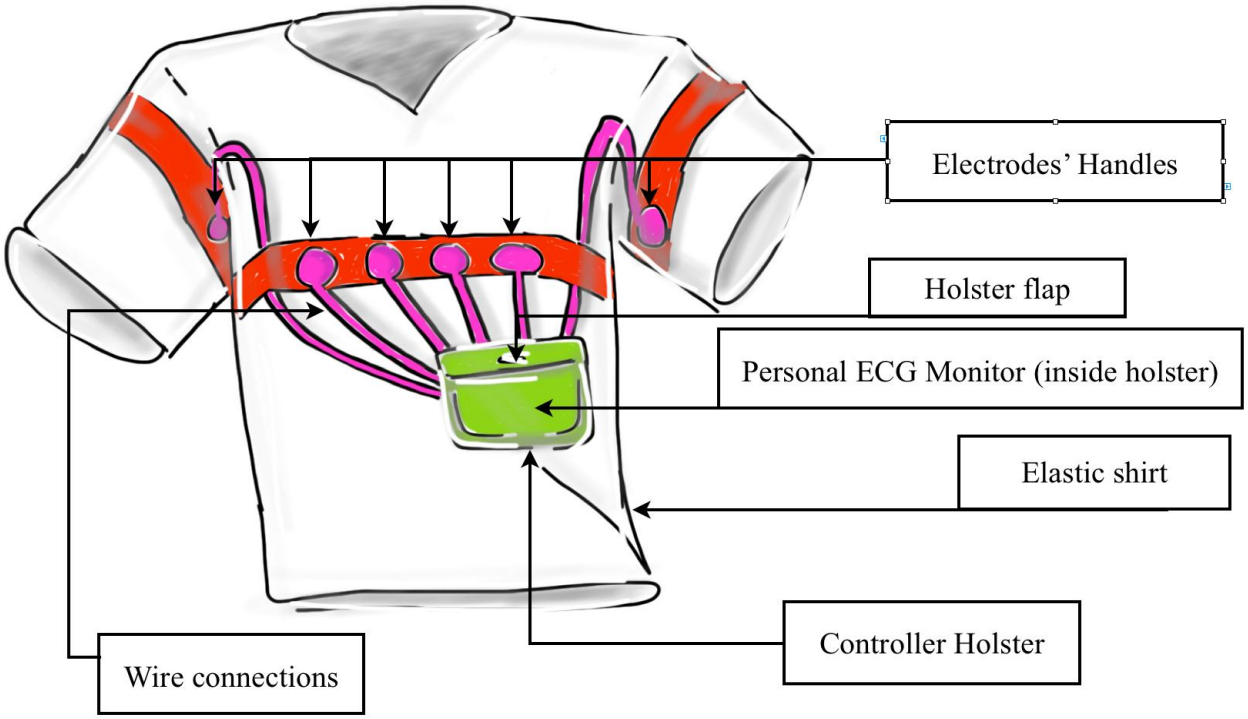


Figure 2-1: Wearable ECG Shirt

3. Customer Requirements

This section establishes in detail customer requirements for each component of eCardiac. Any changes to this section will require the agreement of all stakeholders.

3.1 Unit is unobtrusive to user

3.1.1 Description: The device must be used unfettered to any stationary machinery to allow walking, sitting, turning, bending over, lifting, stretching, laying down, and laying face up.

3.1.2 Source: hardware fragility

3.1.3 Constraints: Moderate to extreme activities may prevent the device from working properly if electrodes are dislodged.

3.1.4 Standards: N/A

3.1.5 Priority: 5

3.2 Normal living environments uninhibited

3.2.1 Description: Homes, assisted living facilities, and other dry indoor spaces are all accessible.

3.2.2 Source: ECG environmental limitations and hardware fragility

3.2.3 Constraints: Environments that do not prevent excessive moisture, encourage moderate climate, and are inundated with electronic interference may cause the device to malfunction. Bathing while wearing device, for example, is not permitted and certain electronics like fluorescent lamps can cause interference with ECG readings

3.2.4 Standards: N/A

3.2.5 Priority: 1

3.3 Automatic emergency notification

3.3.1 Description: Emergency facilities will be notified without user interaction.

3.3.2 Source: Product Manager

3.3.3 Constraints: Emergency detection away from home limits timely symptom reporting.

3.3.4 Standards: N/A

3.3.5 Priority: 2

3.4 Easy product removal from body

3.4.1 Description: Shirt and device will be quickly and easily removable

3.4.2 Source: eCardiac

3.4.3 Constraints: The user must possess the ability required to take off a typical t-shirt.

3.4.4 Standards: N/A

3.4.5 Priority: 3

3.5 Easy shirt cleaning

3.5.1 Description: Shirt must be separately machine washable to promote regular use

3.5.2 Source: eCardiac

3.5.3 Constraints: Shirt color and size may change gradually after repeated washing.

3.5.4 Standards: N/A

3.5.5 Priority: 3

3.6 Lightweight

3.6.1 Description: Device is to be worn all day so it must be light weight.

3.6.2 Source: eCardiac

3.6.3 Constraints: Technology allows for wireless technology and lightweight materials. However, due to budget and time constraints we cannot fully explore every option.

3.6.4 Standards: N/A

3.6.5 Priority: 5

3.7 Language

3.7.1 Description: All documentation / communication relayed by device will be in English.

3.7.2 Source: eCardiac

3.7.3 Constraints: N/A

3.7.4 Standards: N/A

3.7.5 Priority: 2

3.8 Intermittent heart readings

3.8.1 Description: Device will take heart readings periodically

3.8.2 Source: e Cardiac and battery constraints

3.8.3 Constraints: Continuous ECG quickly drains batteries.

3.8.4 Standards: N/A

3.8.5 Priority: 1

3.8 Limited heart readings stored on device

3.8.1 Description: Device will store only a limited interval of heart readings.

3.8.2 Source: eCardiac and storage constraints.

3.8.3 Constraints: The amount we can store will vary depending on device.

3.8.4 Standards: N/A

3.8.5 Priority: 4

3.9 Elastic shirt fabric

3.9.1 Description: In order to insure an accurate reading, the shirt must be made of elastic material. The elasticity will insure that the shirt is tight and will improve ECG Readings.

3.9.2 Source: eCardiac.

3.9.3 Constraints: N/A.

3.9.4 Standards: N/A

3.9.5 Priority: 5

3.10 Product color

3.10.1 Description: Shirt, controller and device container will be black.

3.10.2 Source: eCardiac.

3.10.3 Constraints: N/A.

3.10.4 Standards: N/A

3.10.5 Priority: 5

3.11 Unit Size

3.11.1 Description: The unit attached to the mounting shirt must be relatively small and light to allow the target audience to live without the unit making major impact on their movement. The size should be no larger than thirty six cubic inches (not including the leads or mounting shirt)

3.11.2 Source: Team Cardiac.

3.11.3 Constraints: Being able to place all the required hardware in the limited space may be difficult without extensive knowledge in how to reduce the size of the unit.

3.11.4 Standards: N/A

3.11.5 Priority: 3

3.12 Simple User Interface

3.12.1 Description: Due to the very real possibility of the user having little technical ability or knowledge (e.g. this will likely be targeted at the elderly and most people over 70 seem to have some trouble adapting to new technologies) the basic user interfaces of start-up, sampling, or forced emergency call-out should be easy enough to understand with five minute of instruction.

3.12.2 Source: Team Cardiac.

3.12.3 Constraints: N/A.

3.12.4 Standards: N/A

3.12.5 Priority: 2

3.13 The user must have a modern mobile device to use with the processing unit

3.13.1 Description: The mobile device provided by the user will handle all communication needs to emergency services.

3.13.2 Source: Team Cardiac.

3.13.3 Constraints: The device needs to have access to the internet to obtain the necessary software. The mobile device must have wireless connectivity to interface with the processing unit.

3.13.4 Standards: N/A

3.13.5 Priority: 5

4. Packaging Requirements

In the professional fast paced world that we work in it is necessary to provide our product with a slick professional look. We must insure that the product is easily assembled and ready for use. Below are the packaging requirements for the Personal ECG Monitor.

4.1 Product is battery powered

4.1.1 Description: The energy source for the device will be removable batteries. They will be packaged separately and must be installed by the user.

4.1.2 Source: eCardiac

4.1.3 Constraints: It is up to the customer to change these batteries as often as necessary.

4.1.4 Standards: N/A

4.1.5 Priority: 1

4.2 Electrodes will be detachable and universal

4.2.1 Description: Electrodes will be packaged separately and attached by the user. Electrodes are subject to wear and tear. Our unit must allow for the user to replace the electrodes as needed. Electrodes must also be removed when the garment needs to be washed.

4.2.2 Source: eCardiac

4.2.3 Constraints: It will be up to the customer to determine when the electrodes need changing.

4.2.4 Standards: eCardiac

4.2.5 Priority: 1

4.3 Product will have one primary device casing

4.3.1 Description: The product's ECG processing shall be contained within a single case of plastic or similar material.

4.3.2 Source: eCardiac

4.3.2 Constraints: The user will need enough technical sense to connect a plug and play device.

4.3.4 Standards: N/A

4.3.5 Priority: 1

4. 4 Ready to use processing unit

4.4.1 Description: Processing unit will be enclosed with no exposed wiring or hardware. The software required for processing will be preloaded and functional.

4.4.2 Source: eCardiac

4.4.3 Constraints: Team eCardiac has limited experiencing packaging hardware components.

4.4.4 Standards: N/A

4.4.5 Priority: 1

5. Performance Requirements

5.1 Battery Life minimum

5.1.1 Description: In order to function properly as an emergency alert device, the unit must be capable of continuous use of at least 14 hours

5.1.2 Source: eCardiac

5.1.3 Constraints: Battery size may be an issue, as well as number of batteries.

5.1.4 Standards: N/A

5.1.5 Priority: 2

5.2 Simple Application

5.2.1 Description: Whatever the final form may be the user must be capable of putting the unit on in roughly the same amount of time as a standard article of clothing.

5.2.2 Source: eCardiac

5.2.3 Constraints: The material or form of whatever may keep the unit attached to the customer.

5.2.4 Standards: N/A

5.2.5 Priority: 2

5.3 Status indicator

5.3.1 Description: The unit will indicate to the user that it is working properly or indicate that an error has occurred and maintenance is needed.

5.3.2 Source: eCardiac

5.3.3 Constraints: It will be up to the user to perform maintenance or take the unit to a technician.

5.3.4 Standards: N/A

5.3.5 Priority: 2

5.4 Quick Startup

5.4.1 Description: The unit must be able to startup and be ready for use within two minutes of the customer's prompting.

5.4.2 Source: eCardiac

5.4.3 Constraints: The startup process for the ECG hardware may take longer than two minutes.

5.4.4 Standards: N/A

5.4.5 Priority: 2

5.5 Low Battery Warning

5.5.1 Description: The unit must indicate whether there is sufficient battery power available to function. This will be accomplished by a series of four lights, four indicating full power and one indicating low battery.

5.5.2 Source: eCardiac

5.5.3 Constraints: The user will ultimately be responsible for changing the batteries after the indicator light turns on.

5.5.4 Standards: N/A

5.5.5 Priority: 2

5.6 Processing Interval

5.5.1 Description: The total processing time from the gathering of user input to the call out to 911 must take less than 30 seconds. In order for the unit to be effective it must process the information and call out in as little time as possible

5.5.2 Source: eCardiac and medical standards

5.5.3 Constraints: Limited hardware and software integration experience by team

5.5.4 Standards: N/A

5.5.5 Priority: 1

6. Safety Requirements

6.1 Electrically Safe

6.1.1 Description: Due to the electronics being operated so close to the customer, the unit must not in any way harm the customer.

6.1.2 Source: eCardiac

6.1.3 Constraints: Packaging cost

6.1.4 Standards: No shock may be allowed from either the main unit, or through the ECG leads.

6.1.5 Priority: 1

6.2 Non-Abrasive

6.2.1 Description: Due to the unit being in constant physical contact with the customer the unit should be as smooth and as comfortable as possible to avoid chafing, scratching, or cutting.

6.2.2 Source: eCardiac

6.2.3 Constraints: Lack of constructive knowledge in group to create outer shell, thus any in house fabricated unit may not be as smooth as necessary.

6.2.4 Standards: N/A

6.2.5 Priority: 1

6.3 Non-Constrictive

6.3.1 Description: The means to attach the unit to the customer must not impose a obvious choking or strangulation hazard.

6.3.2 Source: eCardiac

6.3.3 Constraints: Properly sizing each unit to each customer may be problematic.

6.3.4 Standards: N/A

6.3.5 Priority: 2

6.4 Moderately Water-Resistant

6.4.1 Description: The unit must be not cease to function if small to moderate amounts of water are spilled on the casing.

6.4.2 Source: eCardiac

6.4.3 Constraints: N/A

6.4.4 Standards: N/A

6.4.5 Priority: 3

7. Maintenance and Support Requirements

This section establishes in detail the maintenance requirements for users, administrators, and the eCardiac support team. Maintenance may include repair, upgrade, modification and initial set up.

7.1 User Manual Provided

7.1.1 Description: Upon delivery of final product the eCardiac team will provide each user with a general user manual that establishes correct use and self-maintenance.

7.1.2 Source: eCardiac

7.1.3 Constraints: Manual will be in English only. Manual will only include user sanctioned modifications.

7.1.4 Standards: N/A

7.1.5 Priority: 3

7.2 Machine Washable Cloth

7.2.1 Description: Machine washable cloth will be used in fabricating the shirt.

7.2.2 Source: eCardiac

7.2.3 Constraints: Shirt will be available in only one elastic size. Shirt may fade over time.

7.2.4 Standards: N/A

7.2.5 Priority: 2

7.3 User Removable Batteries will be used

7.3.1 Description: User removable batteries will be used to enable users and administrators the ability to change batteries at their leisure.

7.3.2 Source: eCardiac

7.3.3 Constraints: Batteries are replaced at the user's expense.

7.3.4 Standards: N/A

7.3.5 Priority: 2

7.4 Internally Documented Common Repairs

7.4.1 Description: As common repairs are encountered internal documentation will establish their easy repair and, when possible, users and administrators will be notified of possible avoidance strategies.

7.4.2 Source: eCardiac

7.4.3 Constraints: Internal documentation will only be available to Team eCardiac.

7.4.4 Standards: N/A

7.4.5 Priority: 2

8. Other Requirements

8.1 Portable to Windows

8.1.1 Description: The unit must be capable of interface Windows 7; other operating systems are not used by target audience in high enough numbers to merit their use.

8.1.2 Source: eCardiac

8.1.3 Constraints: Cost-Effective hardware may not make portable programming feasible.

8.1.4 Standards: N/A

8.1.5 Priority: 5

8.2 Alert Sound When Callout Occurs

8.2.1 Description: The unit will upon deciding to call 911 emit a short audio file informing the user that the unit will be calling out

8.2.2 Source: eCardiac

8.2.3 Constraints: N/A

8.2.4 Standards: N/A

8.2.5 Priority: 3

8.3 Able to Cancel Call

8.3.1 Description: The user will have access to a method for canceling a call to emergency services in the case of a false alarm.

8.3.2 Source: eCardiac

8.3.3 Constraints: N/A

8.3.4 Standards: N/A

8.3.5 Priority: 3

8.4 Forced Emergency Call-out

8.4.1 Description: The unit must have an easily accessible button on the device which will allow the user to initiate a call-out themselves.

8.4.2 Source: eCardiac

8.4.3 Constraints: N/A

8.4.4 Standards: N/A

8.4.5 Priority: 2

9. Acceptance Criteria

As of now since we do not yet have a specific sponsor, any acceptance criteria will be those which we will assume to be focused on by the customer. Since this is a medical alert device the acceptance criteria will be focusing on overall safety, basic use, and the alert mechanism.

9.1 Verify that the unit is unobtrusive

9.1.1 Requirement addressed: 3.1: Unit is unobtrusive to user.

9.1.2 Verification Procedure: The customer will wear the unit and proceed through a series movement to ascertain ease of movement and comfort while wearing the unit.

9.2 Verify that the unit accurately measures heart activity

9.2.1 Requirement addressed: 2.1: Features and Functions

9.2.2 Verification Procedure: After measuring heart activity with a trusted ECG unit on a specific person, that same person will be measured by the eCardiac unit and after comparing the measurements of the two units the accuracy of eCardiac can be measured.

9.3 Verify that unit when detecting heart attack will contact 911 (or similar service)

9.3.1 Requirement addressed: 2.1: Features and Functions

9.3.2 Verification Procedure: If a sufficient risk of heart attack is sensed then the unit must initiate the call procedure through the user's provided mobile device (for testing purposes a number other than 911 will be utilized). After the call is successfully made the unit can be accepted based on this criterion.

10. Use Cases

This section establishes the workflows associated with each of the different relevant use cases of the eCardiac device.

10.1 User device set up

10.1.1 Scenario: Device is put on properly and turned on.

10.1.2 Actor(s): High risk patient, Patient's Body

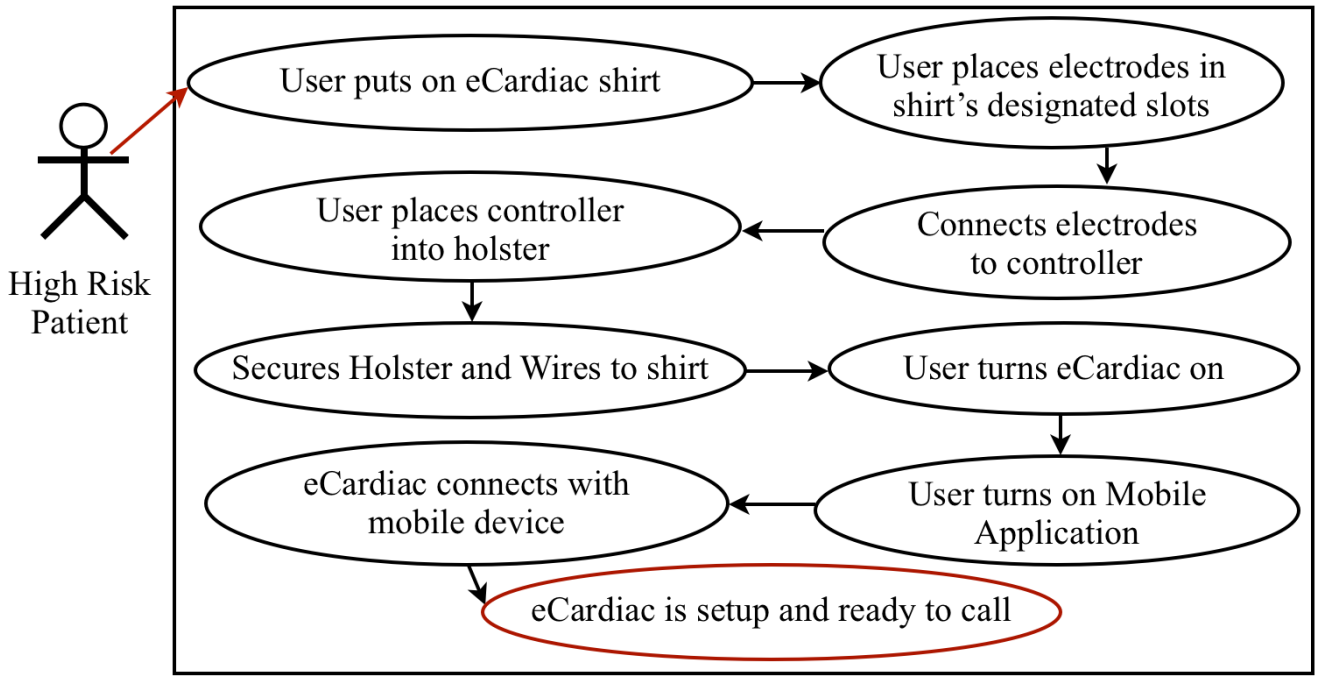

High Risk Patient
User puts on eCardiac shirt
User places electrodes in shirt's designated slots
Connects electrodes to controller
User places controller into holster
Secures Holster and Wires to shirt
User turns eCardiac on
User turns on Mobile Application
eCardiac connects with mobile device
eCardiac is setup and ready to call

Figure 10-1: User Device Set Up

10.2 Monitor heart activity and display heart problems

10.2.1 Scenario: ECG detects heart activity and displays status on phone, with an option for the user to cancel a call to 911 in the event of a problem detected

10.2.2 Actor(s): Patient, Electrode 1, Electrode 2, Electrode N, Central Controller, Notification Device, Emergency Call Center, Patient's mobile phone

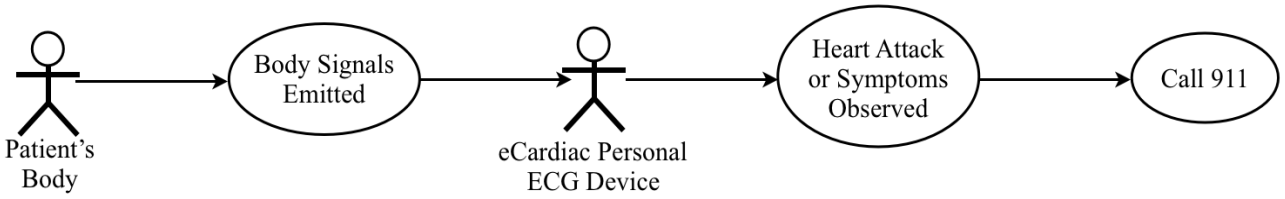


Figure 10-2A: Monitoring Heart Activity

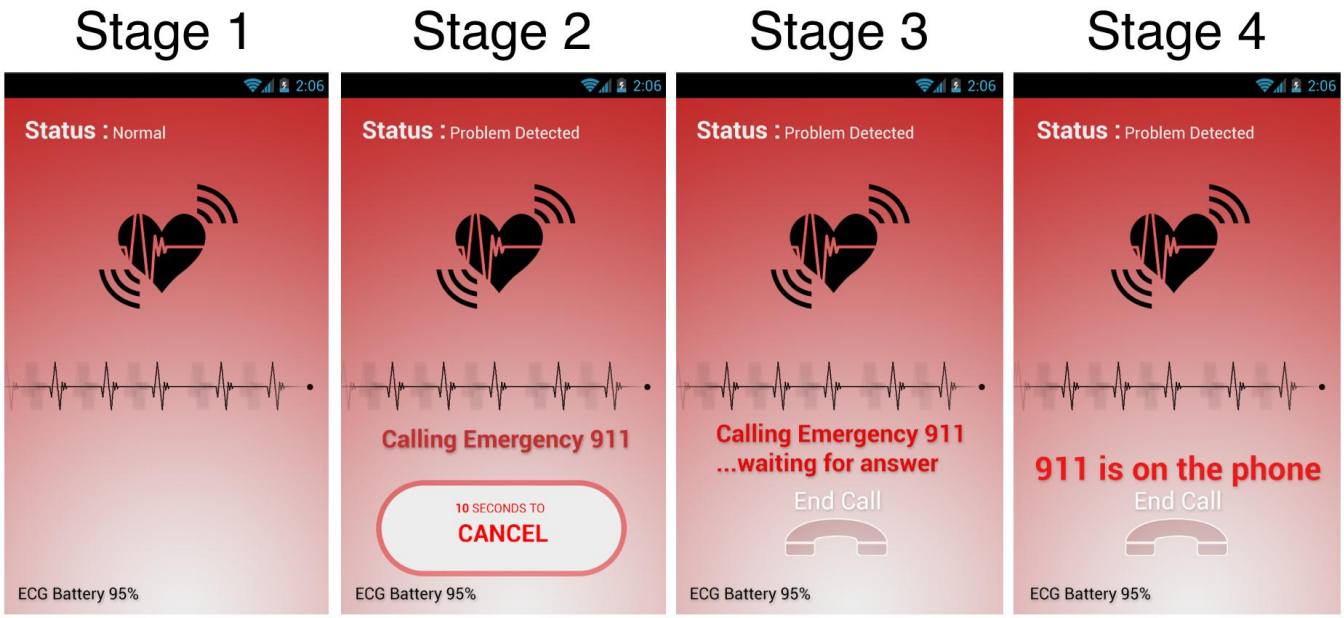


Figure 10-2B: Mobile System Interface

10.3 User washes shirt

10.3.1 Scenario: After extended use, user washes shirt.

10.3.2 Actor(s): Patient

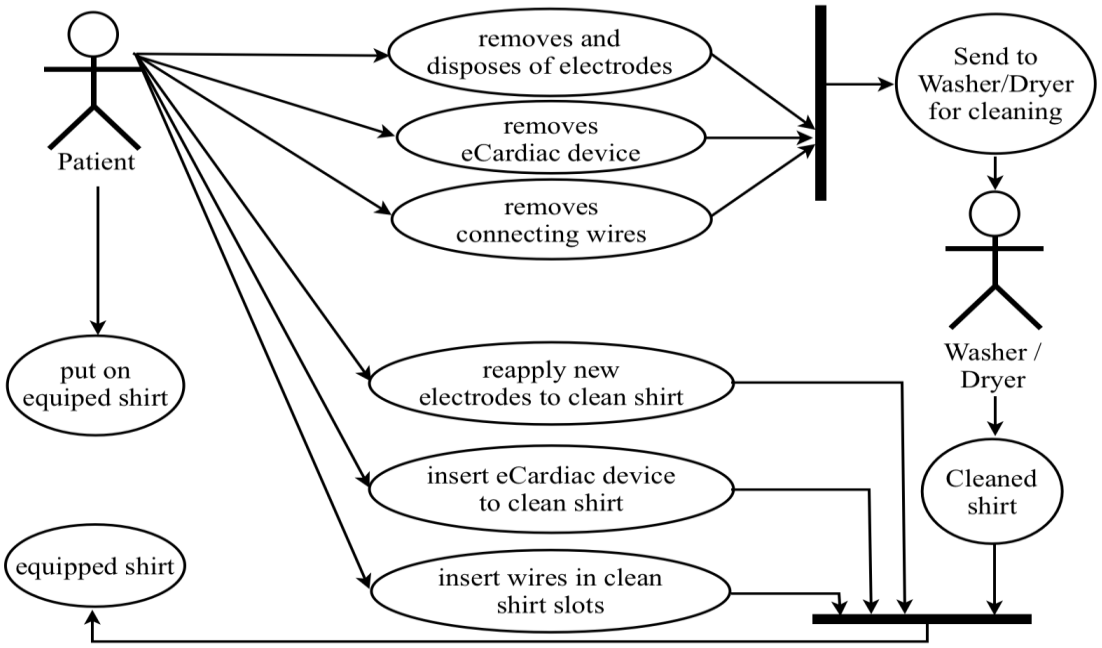


Figure 10-3: User washes shirt

10.4 User downloads the application

10.4.1 Scenario: User installs ECG app on to mobile device

10.4.2 Actor(s): Patient and Patient's mobile phone

Step 1: User Selects Application Store

Step 2: User Searches for eCardiac, clicks on Suggestion for “eCardiac Personal ECG

Step 3: User Selects eCardiac Software

Step 4: User Presses “Download” Button

Step 5: User Presses “Install” Button

Result: Program is installed

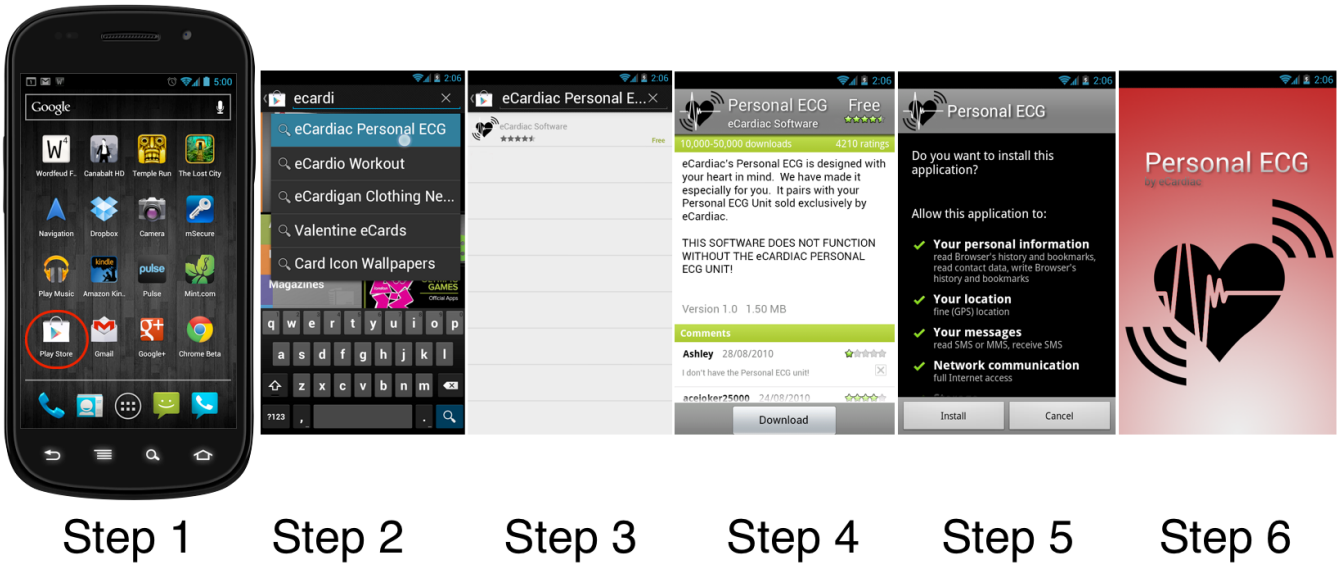


Figure 10-4: User downloads application

11. Feasibility Assessment

11.1 Scope Analysis

Currently based on our skills, research and interaction with other teams who have completed similar project we can safely say that we are capable of both creating a working prototype as well as doing so within our allotted two semester period. Creating this portable ECG/emergency notification unit seems to be well within our capabilities as a five man team in a roughly seven month period. The integration of the various sub-units into a single whole may be difficult but we are certain that our resources as students of UTA will be able to aide us through that issue.

As a whole we feel that the main requirements which demand our primary attention are: 3.1, 3.2, 3.3, and 3.8

11.2 Research

Through some research we have been able to locate several projects and pre-existing units which share many factors with the eCardiac unit. In fact we were able to Marc Handmer who has completed a very similar venture by himself and has been volunteering information about his project and what we may be able to expect in the future.

11.2.1 ECG monitoring

After speaking with our Australian consultant and through some research into basic ECG products, we have found that there is much in the way of pre-existing hardware to supply basic ECG monitoring capability, and many of these units can already sound an alarm when unhealthy activity is detected, so integration into a 'call-out' system should be a reasonable goal.

11.2.2 Emergency Call-out

After doing research into a well advertised product known as life-alert we found that the ability to call out will be a relatively simple one when wiring the ECG device to a 'life-alert like' callout device. There are also other options that give extensive capability to our call out system by interfacing with a mobile device.

11.3 Technical Analysis

This project will have our team utilizing hardware design, customer comfort, telecommunication, and signal analysis.

The hardware design for this unit will not likely be total construction of the e-cardiac unit, but rather attaching and connecting different pre-existing technologies so they may properly interface. The issue with making these connections is two-fold; the technologies must be compatible, and the final combined unit must be unobtrusive to the customer wearing it.

By customer comfort we mean that the unit and it's mounting material must be comfortable enough and must not interfere with the customer's day to day life. This restricts our construction

somewhat being that we must take care not to have the unit take away from the customer's experience.

The telecommunication aspect of this project though rather simple when said aloud may pose problems down the road since none of the current people on this team have extensive knowledge of telecommunication technologies. We may be able to circumvent that issue somewhat by utilizing a pre-existing telecommunication device for our "call-out" functionality.

In order to conduct proper ECG use we will need to be able to create proper algorithms to analyze the signals coming from the leads of the unit, otherwise no accurate data will be found.

11.4 Cost Analysis

Overall we should be capable of making it within our 800 dollar budget, we feel this is the case because right now we could 'somewhat' easily jury-rig a simple version of our final unit with a basic ECG which ranged from 100-300 dollars or make our own for less than 100, some under armor for mounting with negligible cost, and an emergency call out device for around 150 dollars, overall a properly created device will likely put us between 600-700 dollars depending on the hardware we decide to go with.

11.5 Resource Analysis

Our Team consists of two Computer Engineers, and three Computer Scientists. With this mix we should be able to complete our project in a timely and efficient manner, especially since our software requirements should be relatively minimal, but like any senior design project we have some issues. The prime issue we face will be the integration of hardware and software, this is because none of our members have class or work experience in this integration, because of this we need to have contact with our TA's and possibly our eventual sponsor to ensure we do not have problems, or at the very least minimize our chances of having problems.

Most of the other needs in this project should be easily addressed by the experience of the members. We have two members who have had experience with signal analysis in the past, and we have at least one member who has extensive electrical skills for the integration of separate units into a single whole.

11.6 Schedule Analysis

After updating the SRS aver our gate review we've found that both COCOMO and Jones First Order Estimations come to a very similar number of man-months, about 3.5 at minimum with it more than likely being closer to 4.5 for our group as it is it seems quite clear that we should be capable of completing our project within the allotted time.

Now, this calculation is based on the most barebones approach to our unit after additional updates from our gate review. We will be closely following the upcoming weeks of the architecture portion of our project to see if there are errors in this schedule based on incorrect information, and adjust ourselves accordingly.

	Low Complexity			Medium Complexity			High Complexity			Total
Number of Inputs	3	8	24	4	10	40	6	5	0	
Number of Outputs	4	0	0	5	10	50	7	3	21	
Inquiries	3	0	0	4	5	20	6	15	60	
Logical Internal Files	7	0	0	10	10	20	15	5	30	
External Interface Files	5	0	0	7	4	28	10	10	100	
Total Unadjusted Points			**24**			**238**			**316**	**578**

Table 11-1: Function-Point Estimate

Data Communications	**3**	
Distributed data processing	5	
Performance	1	
Heavily used Configuration	4	
Transaction Rate	5	
On-Line data entry	1	
End-user efficiency	2	
On-line update	1	
Complex Processing	3	
Reusability	1	
Installation ease	3	
Operational ease	5	
Multiple Sites	2	
Facilitate Change	2	
TDI	38	
Value Adjusted Factor	1.03	
Adjusted F-P	595.34	
	Group	**Per Person**
First Order Estimation	15.60	3.12
	17.72	3.55
	21.47	4.30

Table 11-2: Jones First-Order Estimate

SIZE	1200
ACAP – Analyst Capability	1.19
AEXP Application Experience	1.13
CPLX Product Complexity	1.15
DATA Database Size	1.00
LEXP Language Experience	.95
MODE Modern Programming Practices	1.12
PCAP Programmer Ability	.86
RELY Required Software	1.40
SCED Required Development Schedule	1.1
STOR Main Storage Constraint	1.00
TIME Execution Time Constraint	1.66
TOOL Use of Software Tools	.91
TURN Computer Turnaround Time	.87
VEXP Virtual Machine Experience	.90
VIRT Virtual Machine Volatility	.87
Effort	5.47 Months
Schedule	4.53 M-Months

Table 11-3: COCOMO